Journal of Banking & Finance 37 (2013) 5275–5284

Contents lists available at SciVerse ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Analyzing determinants of bond yield spreads with Bayesian Model Averaging

Dominik Maltritz [a,*], Alexander Molchanov [b]

[a] Faculty of Economics, Law and Social Sciences, University of Erfurt, Erfurt, Germany
[b] School of Economics and Finance, Massey University, Auckland, New Zealand

ARTICLE INFO

Article history:
Available online 20 July 2013

JEL classification:
F34
G12
G15

Keywords:
Sovereign bond yield spreads
Country default risk
Bayesian Model Averaging

ABSTRACT

This paper analyzes determinants of country default risk in emerging markets, reflected by sovereign yield spreads. The results reported so far in the literature are heterogeneous with respect to significant explanatory variables. This could indicate a high degree of uncertainty about the "true" regression model. We use Bayesian Model Averaging as the model selection method in order to find the variables which are most likely to determine credit risk. We document that total debt, history of recent default, currency depreciation, and growth rate of foreign currency reserves as well as market sentiments are the key drivers of yield spreads.

1. Motivation

Analysis of country default risk is an important issue in international finance. The topic is of particular importance in emerging markets, as the default risk is the primary factor in determining the cost of international capital. Thus, there exists a comprehensive literature on identifying the determinants of country default risk. Empirical papers mostly rely on regression models where a default indicator is regressed on potential explanatory variables. These papers found a great variety of variables significant in explaining default risk. One can observe, however, high variation between the reported regression models and the determinants they include – variables are found to be significant in some papers, whereas in others they lack significance.[1] This indicates a high degree of model uncertainty. Based on this observation, we contribute to the literature by applying Bayesian Model Averaging (BMA) – which explicitly accounts for model uncertainty – to analyze the determinants of country default risk.

The existing empirical literature on country default risk can be grouped by the indicator variable used in the regressions. Popular choices include credit ratings, yield spreads and an indicator variable showing whether a country has defaulted in the recent past. Credit ratings and yield spreads are highly correlated. Spreads, however, tend to lead changes in sovereign bond ratings (see Cantor and Packer, 1996; Larrain et al., 1997), indicating that bond markets are highly efficient in collecting and processing information relevant to country default risk. A comprehensive strand of the theoretical literature proves the relation between yield spreads and (risk-neutral) default probabilities by applying 'reduced-form', also called 'intensity-based,' models (see, e.g., Jarrow and Turnbull, 1995; Jarrow et al., 1997; Duffie and Singleton, 1999; Duffie et al., 2003; Longstaff et al., 2005). In addition to yield spreads, dummy variables that indicate whether a country is in default are used in some studies. We argue that yield spreads are advantageous in capturing default risk to using default dummies. Such dummy variables for defaults provide very crude approximations of the "true" credit risk. Furthermore, there is no unique agreed-upon definition of default.[2] We thus use yield spreads of emerging market bonds to assess default risk. This measure is popular among researchers, with a comprehensive body of literature having been developed following a seminal study by Edwards (1984).

The choice of specific explanatory variables to be included in an empirical investigation should, as far as possible, be guided by

* Corresponding author. Address: Nordhaeusser Strasse 63, 99089 Erfurt, Germany. Tel.: +49 361 73734621; fax: +49 361 73734629.
E-mail address: Dominik.Maltritz@uni-erfurt.de (D. Maltritz).

[1] In our, admittedly incomplete, literature survey, about 50 variables have been shown to have a significant effect on measures of country default risk.

[2] Some researchers define default as an existence of arrears on debt service payments. Others consider assignments of default ratings by major credit agencies. Finally, the situations where large emergency loans are disbursed (e.g. by the IMF) are sometimes considered as defaults.

0378-4266/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jbankfin.2013.07.007

theoretical considerations. When it comes to model specification, however, economic theory gives no full guidance in selecting potential determinants of country default risk. The problem is especially acute in our context. First, there exists a number of variables that potentially influence countries' *ability* to make debt service payments required to avoid a default. Second, an influential strand of theoretical literature (see, e.g. Eaton et al., 1986; Eaton and Fernandez, 1995) emphasizes the importance of a country's *willingness* to make payments since – in contrast to private enterprises – it is hard to enforce payments of sovereign countries. Thus, politics may play an important role in determining countries' default risk and, hence, political variables could also be considered along with economic determinants.

The results documented in the existing literature suggest that there is a high degree of uncertainty about the determinants of emerging markets' yield spreads, and, thus, country default risk. A similar problem is addressed by Sala-i-Martin et al. (2004), who point out that "artistic" economic theory can suggest a very large number of potential explanatory variables. Bayesian Model Averaging (BMA) becomes an attractive modeling choice in such an environment. BMA explicitly acknowledges that the "true" model is not known, and, therefore, analyzes the entire model space (i.e., every possible model that could be constructed from a set of potential independent variables). Data mining concerns are, therefore, mitigated,[3] as the results are based on the entire model space, rather than on a single model.

Bayesian model selection techniques have been used in some prominent studies. Avramov (2002) and Cremers (2002) apply Bayesian techniques to the stock return predictability issue. Vrontos et al. (2008) use BMA to address model uncertainty in hedge fund pricing. Koop et al. (2008) use BMA to account for model uncertainty when investigating the consumption-wealth relationship. Sala-i-Martin et al. (2004), Fernandez et al. (2001b), and Masanjala and Papageorgiou (2008) apply the Bayesian approach to selecting the determinants of economic growth.[4] Bandiera et al. (2010) apply BMA for estimation and prediction of sovereign defaults.[5]

We analyze yield spreads for 35 emerging countries included in the *EMBI+* index for the years 1996–2010. Panel nature of the dataset enables us to control for world-wide events, such as the Asian financial crisis of 1997–1998. In addition to a number of economic variables typically used in yield spread analysis, we include data on political variables obtained from Heritage foundation. Market sentiment can also play an important role in determining sovereign yield spreads, even though it may not impact default probability directly. In order to address this, we include several measures of global and regional sentiment.

As we are interested in basic/fundamental and long-term determinants of default risk, we perform our analysis using annual data. In addition, many economic and political variables are only available in annual frequency. We analyze 34 potential regressors using 374 observations. We document that total debt, history of recent default, currency depreciation, growth rate of foreign currency reserves and global market sentiment (measured by US stock market returns) are among the most important variables determining credit risk. On the other hand, variables commonly found to be significant in determining default risk, such as debt service ratio, budget balance, and inflation rate are found to have low influence on developing countries' default risk.

The rest of the paper is organized as follows. Section 2 presents an overview of some of the existing literature on yield spread determinants. Section 3 presents a brief background on BMA methodology. Section 4 presents the variables and the estimation results. Section 5 concludes.

2. Sovereign yield spreads: prior results

In this section, we provide a brief overview of the main strands of research on determinants of sovereign yield spreads. In general, spreads are supposed to be driven by default risk as well as other influences, such as market sentiments.[6] Our focus is on default risk, where we use the spreads as indicators. Nevertheless, we must keep in mind that spreads are also driven by other factors for which control variables should be included. Before we discuss this in detail, we start with a discussion of the relation between spreads and default risk and its determinants.

A solid theoretical foundation for the relation between spreads and default risk can be found in a strand of the literature that deals with so called 'reduced-form', or 'intensity-based' models. These models analyze the relationship between default probabilities and yield spreads between default risky and secure bonds. This literature shows that these spreads are driven by (risk-neutral) default probabilities. Important examples in this literature are Jarrow and Turnbull (1995), Jarrow et al., 1997, Duffie and Singleton (1999), Duffie et al. (2003), and Longstaff et al. (2005). In reduced form models, typically, the occurrence of defaults is driven by a stochastic process, e.g., a Poisson process. The specific modeling differs between several papers; while in Jarrow and Turnbull (1995), e.g., the hazard rate of the process is assumed to be constant, later papers consider that the hazard rate may change over time (Jarrow et al., 1997), and is, additionally, related to the (stochastic) default-risk-free interest rate and the recovery rate (Duffie and Singleton, 1999). Duffie et al. (2003) consider special features of sovereign borrowers, in particular, that several subsequent defaults are possible for the same borrower.

Given the relation between spreads and default risk, which is theoretically justified in reduced form models, another strand of literature investigates the determinants of default risk by using spreads as risk indicators and regressing spreads on several explanatory variables that are supposed to be the drivers of default risk. Before discussing these results in detail, we start with some remarks on basic theoretical concepts of sovereign defaults and default risk. Here, we can distinguish two important strands. A considerable body of work is focused on a country's ability to pay, i.e. the funds the country is able to utilize for debt servicing. Starting with early work by Domar (1944, 1950), the literature analyzes economic variables which determine development and sustainability of indebtedness. Some other papers from this strand are Avramovic et al. (1964), Solomon (1977), Nowzad et al. (1981), Diaz-Alejandro (1984), and Simonsen (1985). A second strand of the literature emphasizes the importance of willingness to pay. This literature has been developed since the early 1980s (see Eaton et al., 1986; Eaton and Fernandez, 1995, for an overview). The basic idea is as follows: Since the creditors have no means to enforce their claims against a sovereign country, a default may be the result of a government's decision. Therefore, governments weigh pros, such as saved resources, against cons, such as disturbance

[3] In addition, Sala-i-Martin et al. (2004) point out particular applicability of BMA algorithm in case of small samples. See Section 3 for further details.

[4] Other recent papers that utilize BMA include Masih et al. (2010), Ammann and Verhofen (2008), Sidman et al. (2008), Milani (2008), and Hineline (2007).

[5] Although our approach is somewhat similar to that of Bandiera et al. (2010), our paper differs along several key dimensions. First, we analyse sovereign credit spreads, rather than defaults. Second, we employ a wider array of variables. Third, we conduct the analysis in a panel setting, rather than on pooled data.

[6] In addition, also exchange rate risk may influence yield differences. Since we focus on default risk and want to exclude the influence of exchange rate risk, we follow the literature and use yield spreads for instruments denominated in US Dollar and not in domestic currency.